NASA Facts

National Aeronautics
and Space Administration

Langley Research Center
Hampton, Virginia 23681
Office of Public Affairs

FS-1996-08-06-LaRC

Assignment: *Design a Spaceship*

Requirements – *It must:*

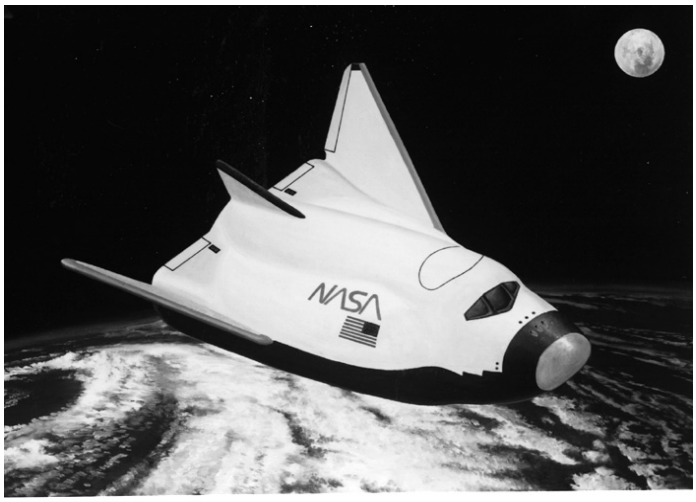
- ***achieve mission with payload and/or passengers.***
- ***be easily and economically produced and maintained.***
- ***be reusable and have as few stages as possible to reduce cost and recover expensive materials.***
- ***pass all engineering and flight tests.***
- ***BE COST EFFECTIVE.***

Engineers at NASA's Langley Research Center must consider many questions as they design the next generation of space vehicles. Their approach is not ***CAN*** they do it, but ***HOW*** can they do it ***BETTER*** than before and more cost effectively.

One of Langley's jobs is to create new and innovative technologies to meet the challenges of space flight and lower the cost of future space missions. With technological advances in many areas and expanded needs and capabilities of space missions, NASA researchers face unlimited possibilities. As they work through a series of steps from concept inception to full-scale design, they may hit stumbling blocks and be forced to retrace their steps and sometimes even start over. At every turn, however, they are pioneering their way through science and engineering, turning theories into reality. Their designs must pass final qualification tests and be proven cost efficient. Only then will they be considered for service.

What is a Spaceship

A spaceship is designed to travel in space and may be launched from Earth by a launch vehicle. It may carry a payload to accomplish a mission with or without people and return to Earth.

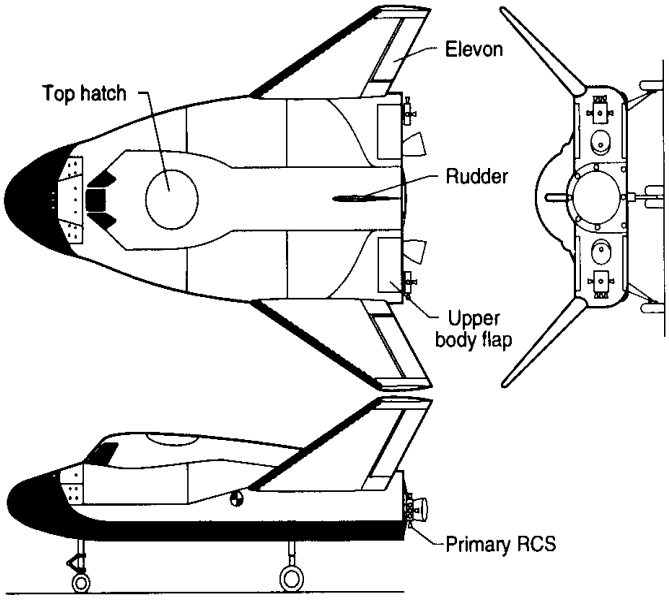


HL-20. This personnel transporter has made it to the mock-up stage and awaits further approval before being built.

5 STEPS TO BLASTOFF

☑ STEP ONE: *Mission Purpose*

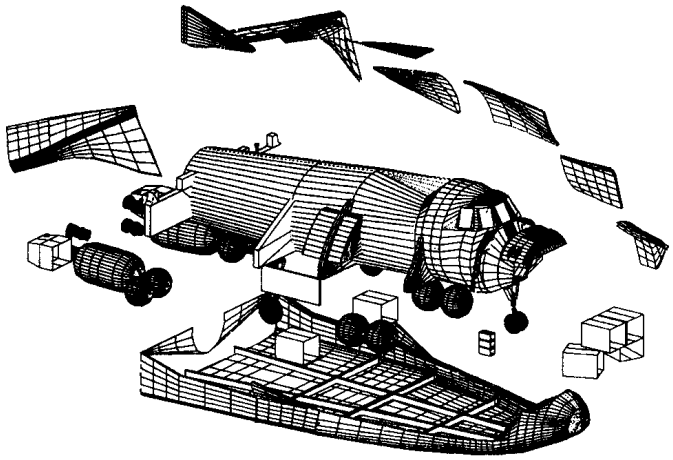
What is the purpose of the mission? That question begins the avalanche of other questions which lead toward design requirements. What is the payload, how big is it, how much acceleration and entry heating must it take? Once these, and many more requirements are decided, a study is done to determine whether the mission performance requirement can be met.



Step 1. The HL-20 was designed by NASA Langley to carry astronauts back and forth to the space station and to serve as an emergency return vehicle while they are there.

☑ STEP TWO: *Design*

The nature of the payload and its special needs help determine the design — shape, size and configuration — of the space vehicle. If people



Step 2. Researchers considered various configurations for the HL-20. External access to subsystems, to allow for easy maintenance, and enough room for eight passengers were two top priorities.

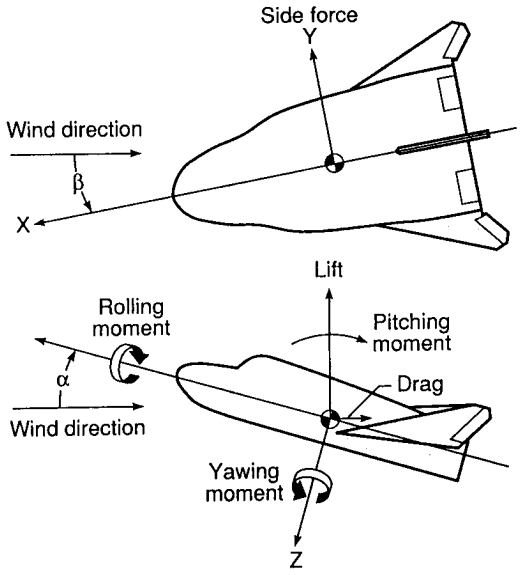
are going, there are obvious unique requirements, such as seating capacity, entrance and exit hatches and access to certain systems.

The configuration of the spacecraft must provide for all of the support systems, such as communications, electrical systems and life support.

☑ STEP THREE: *Analyses*

NASA Langley engineers must determine the craft's general operation before launch and upon its return. They must analyze the aerodynamic, or air flow, characteristics of the configuration, as well as monitor structural stress, effects of high speed, heat tolerances and the performance trajectory, or course it flies to space and back.

Engineers must consider appropriate new materials for the spaceship that could minimize cost and weight. Every pound of extra structure may take up to 10 pounds more in total launch



Step 3. The HL-20 design was analyzed for aerodynamics in wind tunnels and by computer, to understand how the air would flow around it and would affect its flight into space and back.

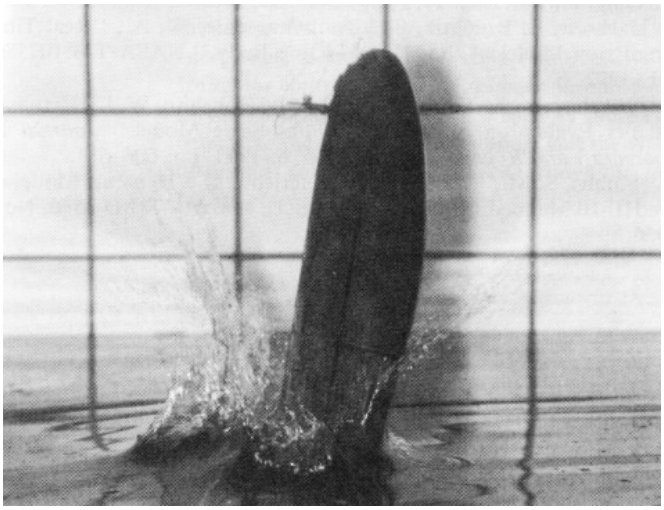
weight to get it into space — and back. And every pound of structure raises the cost of the mission.

☑ STEP FOUR: *Testing*

Once the spaceship has been designed, it must be certified for flight through a series of performance, vibration and thermal tests. It is now time to test the actual structure with models of the design.

It is not necessary to build an entire spaceship for initial testing. Instead, engineers build and test the individual components. A wing, for example, may be subjected to tests that are not appropriate for any other part of the vehicle.

After initial testing, any parts of the spaceship structure or internal systems which do not meet performance requirements are then redesigned and retested.

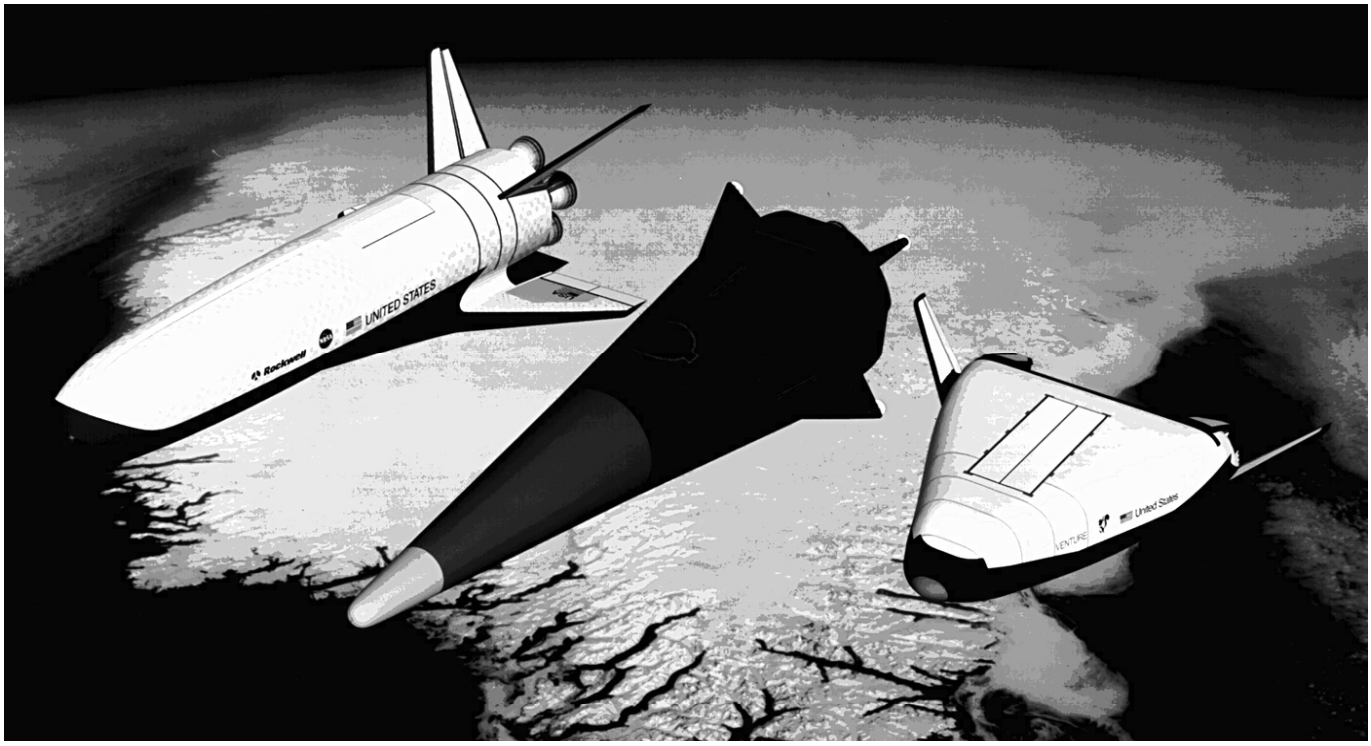


Step 4. Water entry tests using a small-scale model of the actual design.

☑ STEP FIVE: *Fabrication*

Once a final design passes initial tests, a full-scale model, or mock-up, is fabricated in fiber glass or other inexpensive materials. Afterward, an actual prototype, called the flight model, may be built and then tested to assure the quality of design. If it passes many hours of tests including a series of experimental flight tests, it is ready for production and operation.

Step 5. A mock-up of the interior design of the HL-20 enables real astronauts to determine if they can move and function as planned.



NASA Langley researchers contributed their expertise to all three X-33 prototypes. The X-33 prototype on the right, from Lockheed Martin, was chosen for further development and testing.

Next Generation Has Arrived

Current space missions require a launch vehicle with rocket stages to get a spaceship such as the HL-20 into space. As we approach the new millennium, NASA Langley is using its experience to help industry develop and introduce the next generation of space vehicles. One of its top priorities is a fully reusable spaceship, a launch vehicle, which would fly to space and back as a single unit or single stage. Depending on the mission, the reusable launch vehicle could support sophisticated, high-precision, deployable instruments for specific scientific research. A prototype of this vehicle, the X-33, is slated to fly in 1999.

NASA Langley engineers also have an active role in the design of the International Space Station, the components of which are currently being built.

Summary

NASA Langley's current development of next generation launch vehicles follows a systemized course from inception to prototypes to flight vehicles. With the goal to reuse vehicle components and eliminate multi-stage rockets, NASA Langley researchers have brought us into the 21st Century and will continue to meet the ever changing and expanding requirements of space missions.

For more information contact:

Office of Public Affairs
Mail Stop 115
NASA Langley Research Center
Hampton, VA 23681-0001
(757) 864-6123
http://www.larc.nasa.gov/org/pao